From the Society for Vascular Surgery

Perioperative management with antiplatelet and statin medication is associated with reduced mortality following vascular surgery

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Objective: **Many patients undergoing vascular surgical procedures are not on appropriate medical therapy. This study sought to examine the variation and impact of antiplatelet (AP) and statin therapy on early and late mortality in patients undergoing vascular surgery in our region.**

Methods: **We studied all patients (n = 14,489) undergoing elective carotid endarterectomy (n = 6978), carotid stenting (n = 524), and suprainguinal (n = 763) and infrainguinal bypass (n = 3053), as well as patients with known coronary risk factors undergoing open (n = 1044) and endovascular (n = 2127) abdominal aortic aneurysm repair from 2005 to 2012 in the Vascular Study Group of New England. Optimal medical management was defined as treatment with both AP and statin agents, preoperatively and at discharge. We analyzed temporal, procedural, and center variation of medication use. Multivariable analyses were used to determine the adjusted impact of AP and statin therapy on 30-day mortality and 5-year survival.**

Results: **Optimal medical management improved over the study interval (55% in 2005 to 68% in 2012; *P* trend < .01) with carotid interventions having the highest rates of optimal medications use (carotid artery stenting, 78%; carotid endarterectomy, 74%) and abdominal aortic aneurysm repair in patients with known cardiac risk factors having the lowest (open, 57%; endovascular aneurysm repair, 56%). Optimal medication use varied by center as well (range, 40%-86%). Preoperative AP and statin use was associated with reduced 30-day mortality (odds ratio, 0.76; 95% confidence interval [CI], 0.5-1.05; *P* = .09). AP and statin prescription at discharge was additive in survival benefit with improved 5-year survival (hazard ratio, 0.5; 95% CI, 0.4-0.7; *P* < .01) that was consistent across procedure types. Patients prescribed AP and statin at discharge had 5-year survival of 79% (95% CI, 77%-81%) compared with only 61% (95% CI, 52%-68%; *P* < .001) for patients on neither medication.**

Conclusions: **AP and statin therapy preoperatively and at discharge was associated with reduced 30-day mortality and an absolute 18% improved 5-year survival after vascular surgery. However, one-third of patients are suboptimally managed in real world practice. This demonstrates an opportunity for quality improvement that can substantially improve survival after vascular surgery. (J Vasc Surg 2014;59:1615-21.)**

Peripheral arterial disease (PAD) and abdominal aortic aneurysms (AAAs) are prevalent conditions encountered by vascular surgeons with a high rate of associated cardiovascular disease.[1,2] Only 8% of patients undergoing major vascular surgical procedures have nondiseased coronary arteries.[3] This results in a high incidence of clinical coronary and cerebrovascular disease among those with PAD and AAA.[1,4] Patients with AAA have a two-fold higher risk of heart attack and 1.8-fold higher risk of stroke compared with population-based controls,[5] and approximately 75% of those with PAD will ultimately die from cardiovascular causes.[1,6]

Despite their high prevalence of cardiac disease, many patients undergoing vascular surgery are not prescribed appropriate cardiovascular medications, including antiplatelet (AP) medications (aspirin or clopidogrel) and HMG-CoA reductase inhibitors (statins). Of all PAD patients, 40% to 60% are not on AP agents, and 40% to 70% are not on statins.[7,8] This is correlated with increased risk of mortality, even in those with no known associated coronary artery disease (CAD).[8]

The variation in optimal medication management among patients undergoing vascular surgery in real world practice has not been described. Further, the benefit of optimal medication utilization is not known in this patient subset. The purpose of this study was to define the variation in perioperative medication usage among patients

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undergoing vascular surgery in New England. We also analyzed the effect of optimal medication utilization on postoperative survival.

METHODS

Subjects and database. This is a retrospective analysis of data collected prospectively by the Vascular Study Group of New England (VSGNE), a regional cooperative quality improvement initiative developed in 2002 to study regional outcomes in vascular surgery.[9] Of note, registry data are compared with hospital claims in annual audits, and missing cases are retrieved to yield a >99% complete capture rate for all tracked procedures.[9] Mortality data is supplemented by semiannual matching of registry data with the Social Security Death Index (SSDI). Data from 2003 and 2004 was excluded since discharge statin use was not tracked until 2005. We selected all patients from 2005 to 2012 undergoing their first time interventions in the VSGNE for carotid endarterectomy (CEA), carotid artery stenting (CAS), infrainguinal and suprainguinal arterial bypass, and AAA repair (open [oAAA] or endovascular [EVAR]). This yielded our initial cohort of 17,806 patients. These patients were selected because multiple guidelines support AP and statin use for cerebrovascular disease and symptomatic PAD.[1,6,10-12] Patients undergoing AAA repair were only included if they had known coronary risk factors that support both aspirin and statin use,[13] including a history of CAD, hypertension, positive stress test, prior coronary revascularization, a prior arterial bypass or peripheral intervention, or prior carotid revascularization. Only 366 (10%) of all eligible AAA repairs were excluded. Of note, these excluded patients with AAA had similar perioperative mortality, but slightly better overall survival than the remaining AAA patients (78% vs 71% at 5 years). All cases were elective; urgent or emergent cases were excluded (2263 emergent and 681 urgent). These exclusion criteria were designed to provide a cohort of patients with the potential to be placed on AP and statin medications before elective surgery. Finally, patients were removed from analysis for missing preoperative medication data (n = 5). This resulted in 14,489 patients with data available for 30-day analysis (Fig 1). Our 5-year survival analysis was based on the hypothesis that survival may be affected by medications prescribed at discharge. Therefore, we excluded patients from the 5-year survival analysis if they died in-hospital postoperatively (n = 111) or had missing discharge medication data (n = 629). This left 13,749 patients for 5-year survival analysis (Fig 1).

Statin use was defined as being on any type of statin medication at any dose. Patients were considered on AP medication if they were on aspirin (any dose) or any P2Y12a antagonist (commonly clopidogrel). Preoperative medication use was defined as taking the medication within 36 hours of surgery. Patients classified as being intolerant to AP and statin were considered as not taking these medications (only four patients were intolerant to any AP, and 181 were intolerant to statins). Patients were not assessed for medication adherence at any point, and no serological tests were done on drug efficacy, lipid levels, or other biochemical markers.

Long-term survival was determined from the VSGNE database and by matching patient information with the SSDI. There is no information on any patient's cause of death, only the time from the procedure until their death. Patients not in the SSDI or not having a hospital record of dying were considered alive with survival days ending at the time of data harvest (December 2012). Definitions of medical comorbidities in the VSGNE cohort have been previously published.[14]

Data collection and statistical analysis. Physicians, nurses, or clinical data abstractors entered data prospectively on clinical and demographic variables. Research analysts were blinded to patient, surgeon, and hospital identity. The Committee for the Protection of Human Subjects at Dartmouth Medical School has approved the use of deidentified data from VSGNE for research purposes.

Optimal medical management was defined as AP and statin use preoperatively and at discharge. Our primary outcomes were 30-day death and 5-year survival. Patients were stratified by their medication utilization (none, AP only, statin only, or both). To study 30-day death, preoperative variables were compared using χ^2 for categorical variables with Fisher exact correction if event rates were low. A two-sample *t*-test or Wilcoxon rank sum test was used to compare normal or non-normal continuous data respectively. Variables with a *P* value of <0.1 were included in a backwards stepwise logistic regression analysis to identify factors associated with 30-day death. For survival analysis, univariate comparisons were made with log-rank or Cox proportional hazards for categorical and continuous variable respectively starting at 30 days to exclude events within 30 days. Variables of clinical significance and those with a *P* value of <0.1 by univariate survival analysis were included in a backwards stepwise multivariable Cox proportional hazards model to identify significant predictors of long-term mortality. Variables for both logistic and Cox models were removed using the likelihood ratio test. Continuous variables with nonlinear risk were categorized for analysis. Age was categorized by quartiles. Probability values of <0.05 were considered significant. Analyses were done using Stata release 11 (Stata Corp, College Station, Tex).

RESULTS

Patient population and medication variation. From 2005 to 2012, a total of 14,489 patients underwent their first elective procedure in the VSGNE, of which, 52% were for carotid interventions, 26% arterial bypass, and 22% AAA repair (Fig 2). Patients on average were 70 years of age (standard deviation, 9.9) and male (66%). Prevalent comorbidities included hypertension (89%) and history of tobacco use (84%). Less common comorbidities included; diabetes (32%), CAD (33%), chronic obstructive pulmonary disease (COPD; 26%), and congestive heart failure (CHF; 10%; Table I).

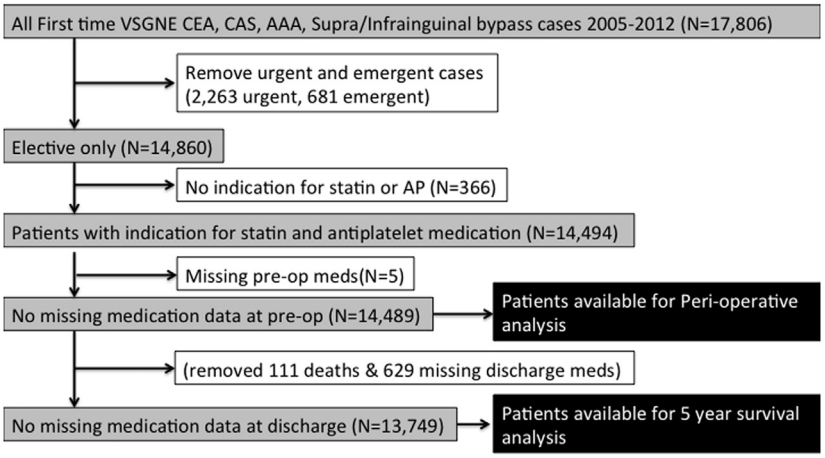

Fig 1. Identification patients in the Vascular Study Group of New England (*VSGNE*) for analysis. *AAA,* Abdominal aortic aneurysm; *AP,* antiplatelet (aspirin or clopidogrel); *CAS,* carotid artery stenting; *CEA,* carotid endarterectomy.

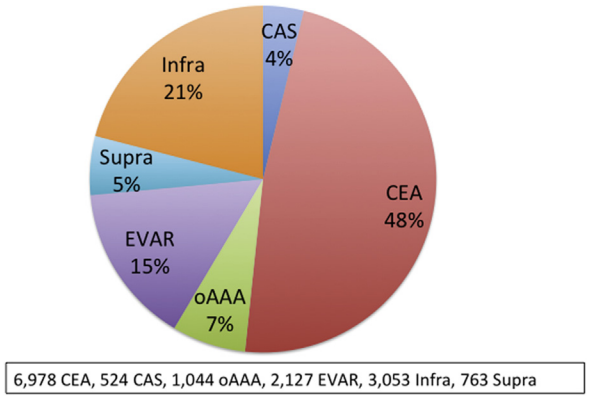

Fig 2. Distribution of cases among patients undergoing primary elective operation in the Vascular Study Group of New England (VSGNE), 2005-2012. *CAS,* Carotid artery stenting; *CEA,* carotid endarterectomy; *EVAR,* endovascular aortic aneurysm repair; *Infra,* infra-inguinal artery bypass; *oAAA,* open abdominal aortic aneurysm repair; *Supra,* suprainguinal artery bypass.

Over the study interval, the use of optimal medical management (AP and statin preoperatively and at discharge) increased, notably from 55% in 2005 to 70% in 2009, after which it plateaued (P trend $< .01$; Fig 3). The rate of optimal medication use varied by procedure. Carotid interventions had the highest rate of medication utilization (78% for CAS; 74% CEA) and AAA repair the lowest (57% oAAA; 56% EVAR). Optimal medication use after bypass procedures was intermediate (60% infrainguinal; 57% suprainguinal; Fig 4, *a*). Within each procedure, there was wide variation in optimal medical management across individual medical centers within the VSGNE (Fig 4, *b*). As a result, there was wide center variation in the use of optimal medical management across all procedures, ranging from 40% to 86% of patients seen at each center (Fig 5). Even when low volume centers (<100 cases) were excluded, there was still wide variation (43% to 76%; Supplementary Fig, online only).

Thirty-day mortality. During the study interval, 167 patients (1.2%) died within 30 days of surgery. This corresponded to a mortality rate for CAS of 0.6%, CEA 0.5%, oAAA 2.8%, EVAR 1.1%, suprainguinal 2.4%, and infrainguinal 1.8% bypasses. When analyzed by preoperative medication status (none, AP only, statin only, or both), patients on both medications had the lowest 30-day mortality rate (1.8% none; 1.1% AP only; 2.3% statin only; 0.9% both; $P < .001$ across groups and none vs both $P = .02$). However, there was no statistical difference when patients on neither medication were compared with AP only or statin therapy only ($P = .1$ and $P = .5$, respectively). In multivariable logistic analysis, AP and statin medication usage preoperatively was associated with a trend towards lower 30-day mortality (odds ratio, 0.75; 95% confidence interval [CI], 0.5-1.05; $P = .09$; Table II). Other significant factors associated with 30-day mortality included increasing age, CAD, CHF, COPD, non-independent living status, and being on dialysis (Table II). Smoking status (current or former) was not significantly associated with 30-day mortality.

Five-year survival. Overall, the 5-year survival rate was 76% (95% CI, 75%-78%). Survival was higher among those discharged on both AP and statin therapy (79%; 95% CI, 77%-81%) compared with patients on suboptimal therapy (70%; 95% CI, 67%-73%; $P < .001$). This trend persisted for each procedure when analyzed separately (Supplementary Table, online only). When evaluated by discharge medication status, patients on both agents had the highest overall survival at 79% (95% CI, 77%-81%) compared with neither medication (61%; 95% CI, 52%-68%; $P < .001$). Patients on either medication had intermediate survival of 74% (95% CI, 68%-79%) for statin only and 72% (95% CI, 69%-75%) for AP only ($P > .05$ between single agent only; Fig 6). In multivariable survival analysis, patients discharged on both AP or statin medications had an improved 5-year survival (statin hazard ratio [HR], 0.7;

Table I. Patient characteristics in the Vascular Study Group of New England (VSGNE) undergoing first time elective procedures (2005-2012)

Patient characteristics (N = 14,489)	*%*
Mean age, years (SD)	70 (9.9)
Male	65.6
Smoking	
Never	16.2
Former (>1 year)	49.5
Current (within 1 year)	34.3
Hypertension	88.9
Diabetes	
No	68.4
Diet-controlled	5.7
Oral medications	15.6
Insulin	10.4
CAD	
None	67.4
Prior MI	20.7
Stable angina	10.1
Unstable angina/recent MI	1.9
Any CABG/PTCA	31.2
CHF	
None	90.2
Asymptomatic	5.9
Mild	3.1
Severe	0.8
COPD	
No	74.0
Diagnosis, not treated	10.4
On medication	13.4
On oxygen	2.2
Dialysis	1.6
Creatinine >1.8 mg/dL	5.8
All stress tests	
Not done	58.5
Normal	29.3
Abnormal	12.2
AP use	85.5
Intolerant	<0.1
Statin	77.5
Intolerant	1.3
Beta-blockers	
None	22.3
Perioperative	16.9
Chronic	58.9
Intolerant	1.1
Intraoperative only	0.8

AP, Antiplatelet medication (aspirin or clopidogrel); *CABG,* coronary artery bypass graft; *CAD,* coronary artery disease; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *MI,* myocardial infarction; *PTCA,* percutaneous transluminal coronary angioplasty; *SD,* standard deviation.

95% CI, 0.5-0.9; AP HR, 0.7; 95% CI, 0.6-0.9) compared with patients on neither medication ($P < .001$). Patients on both AP and statin medications had the largest survival benefit (HR, 0.5; 95% CI, 0.4-0.7), even when adjusting for age, comorbidities, and procedure (Table III). Other factors that were associated with decreased 5-year survival included patients' age, smoking status, diabetes, CAD, CHF, COPD, chronic renal disease, nonindependent living status before operation, and a prior amputation or bypass (Table III).

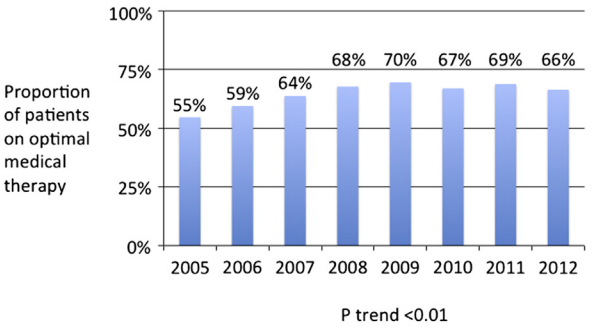

Fig 3. Use of optimal medication over time in the Vascular Study Group of New England (VSGNE). Optimal medical therapy, Taking antiplatelet (AP) and statin medication preoperatively and at discharge.

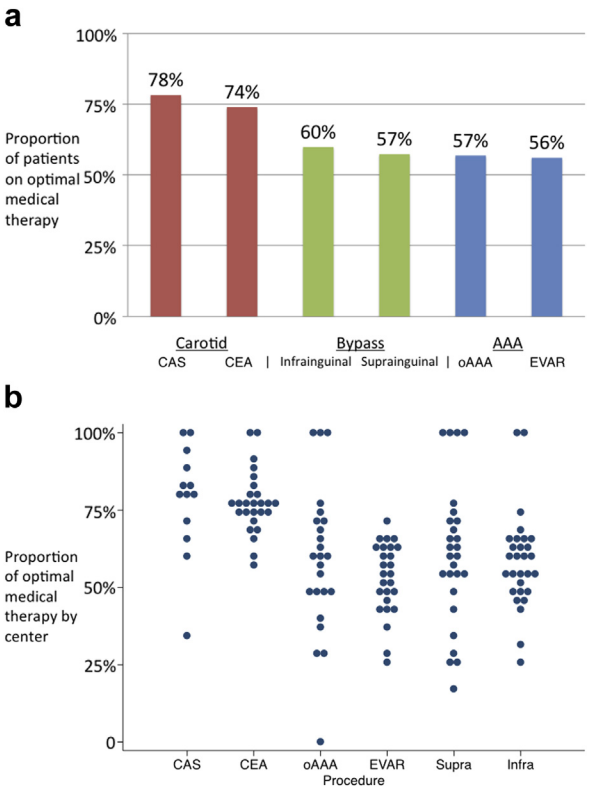

Fig 4. a, Proportion of patients on optimal medical therapy across procedures in the Vascular Study Group of New England (VSGNE). **b,** Proportion of patients on optimal medical therapy across procedures in the VSGNE. *AAA,* Abdominal aortic aneurysm; *CAS,* carotid artery stenting; *CEA,* carotid endarterectomy; *EVAR,* endovascular aortic aneurysm repair; *Infra,* infrainguinal artery bypass; *oAAA,* open AAA repair; *Supra,* suprainguinal artery bypass.

DISCUSSION

Patients requiring vascular surgery carry a significant cardiac disease burden. PAD is a significant cardiac risk factor, and most patients with symptomatic PAD will die from their cardiac disease.[1,6] Potentially underappreciated is that

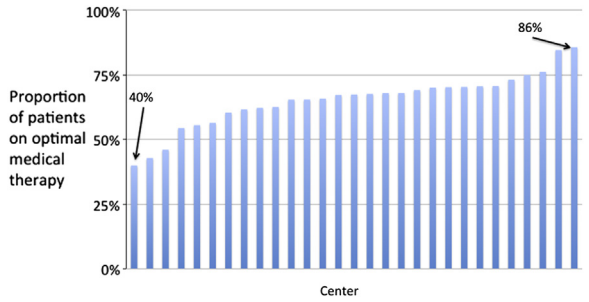

Fig 5. Variation in optimal medical therapy across Centers in the Vascular Study Group of New England (VSGNE) (2005-2012).

Table II. Multivariable model for 30-day death

Variable	*OR*	*95% CI*	P
Age, years	1.06	1.04-1.08	<.001
CAD	1.74	1.25-2.4	.001
CHF	1.78	1.21-2.62	.003
COPD	1.77	1.28-2.44	<.001
Nonindependent living preoperatively	3.78	2.04-7.03	<.001
Dialysis	4.36	2.48-7.68	<.001
Preoperative AP and statin	0.75	0.55-1.05	.09
Area under curve = 0.76			

AP, Antiplatelet agents (aspirin or clopidogrel); *CAD,* coronary artery disease; *CHF,* congestive heart failure; *CI,* confidence interval; *COPD,* chronic obstructive pulmonary disease; *OR,* odds ratio.

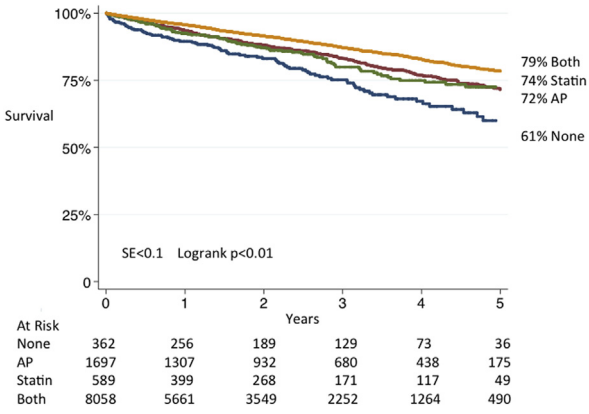

Fig 6. Five-year survival following surgery by discharge medication status. *AP,* Antiplatelet medication.

patients with AAA are also at increased risk for cardiovascular disease and mortality.[5] Medical management for patients with symptomatic PAD and known cardiac disease is well outlined and endorsed by several multidisciplinary guidelines.[1,6,10,12] This treatment includes the use of AP and statin agents to reduce the incidence of cardiovascular events in addition to glucose control in diabetics, smoking cessation, and blood pressure control.[1,6,10,13] This present study has demonstrated that despite the known benefits of these agents, their use in clinical practice is associated with

Table III. Multivariable factors associated with 5-year survival following vascular surgical procedures

	OR	*95% CI*	P
Age, years			
≤63	1.0 (ref)		
64-70	1.5	1.3-1.9	<.001
71-77	2.0	1.6-2.4	<.001
≥78	4.0	3.3-4.9	<.001
Female	1.0	0.9-1.1	.83
Smoking status			
Never	1.0 (ref)		
Former (>1 year)	1.2	1.04-1.5	.014
Current (within 1 year)	1.3	1.1-1.6	.005
Diabetes			
None	1.0 (ref)		
Diet-controlled	1.1	0.89-1.41	.32
Oral medications	1.1	0.9-1.3	.09
Insulin	1.4	1.2-1.7	<.001
CAD			
None	1.0 (ref)		
Prior MI	1.2	1.1-1.4	.002
Stable angina	1.4	1.2-1.7	<.001
Unstable angina/recent MI	1	0.6-1.8	.87
CHF			
None	1.0 (ref)		
Asymptomatic	1.5	1.3-1.9	<.001
Mild	1.7	1.4-2.1	<.001
Severe	1.6	1.0-2.6	.03
COPD			
None	1.0 (ref)		
Diagnosis, not treated	1.2	1.0-1.4	.03
On medications	1.5	1.2-1.7	<.001
On oxygen	2.4	1.9-3.1	<.001
eGFR			
≥60	1.0 (ref)		
40-59	1.1	1.0-1.3	.06
30-39	1.2	1.0-1.5	.04
<30	2.4	1.9-2.9	<.001
Missing	2.6	2.1-3.2	<.001
Nonindependent living status	2.0	1.4-2.8	<.001
Prior bypass	1.4	1.2-1.7	<.001
Prior amputation	1.5	1.1-2.2	.027
Discharge medication			
None	1.0 (ref)		
Statin	0.7	0.5-0.9	.008
AP	0.7	0.6-0.9	.005
Both	0.5	0.4-0.7	<.001
Procedure			
CAS	1.0 (ref)		
CEA	0.6	0.5-0.9	.002
oAAA	0.7	0.5-0.9	.03
EVAR	0.8	0.6-1.1	.13
Suprainguinal bypass	1.1	0.7-1.8	.73
Infrainguinal bypass	1.2	0.9-1.6	.13

AP, Antiplatelet medication (aspirin or clopidogrel); *CAD,* coronary artery disease; *CAS,* cardiac artery stenting; *CEA,* carotid endarterectomy; *CHF,* congestive heart failure; *CI,* confidence interval; *COPD,* chronic obstructive pulmonary disease; *eGFR,* estimated glomerular filtration rate (mL/min/1.73 m^2); *EVAR,* endovascular aneurysm repair; *MI,* myocardial infarction; oAAA, open *OR,* odds ratio.

significant variation. Importantly, patients on optimal medical therapy have lower perioperative mortality and an absolute 18% improved 5-year survival. Such a survival improvement is difficult to improve in these patients, and

may be equivalent to the survival benefit obtained by repairing their AAA.

Despite the known benefits of AP and statins, ensuring that patients are on them may be difficult. Even patients in randomized controlled trials are not routinely on these agents. Although the Bypass vs Angioplasty in Severe Ischaemia of the Leg (BASIL) trial is several years old, patients had AP usage rates preoperatively of 54% and statin use of 34%.[15] Similarly, low use of AP agents was seen in the Open vs Endovascular Repair (OVER) trial for AAA repair.[16] In comparison, recent carotid studies have had much higher adherence to AP and statin agents. In the Carotid Revascularization Endarterectomy vs Stenting Trial (CREST), >90% of patients were on AP agents before and after their procedure,[17] and >85% of patients were on lipid-lowering agents.[18] These findings mirror our finding that patients undergoing carotid interventions are more likely to be on optimal medical management compared with patients with PAD or AAA in the VSGNE.

Undertreatment of PAD has gained recent attention.[19] In the National Health and Nutrition Examination Survey (NHANES), it is estimated that approximately 7 million Americans have PAD. Yet, only 30% are on statin medications and 35% on aspirin. This leaves over 4.5 million American undertreated for their PAD. Patients on multidrug therapy had a 65% adjusted reduction in mortality.[8] A similar Danish longitudinal study demonstrated that although use of AP and statins increased in the early 2000s, only 53% of patients with PAD were on an aspirin, and 40% were on a statin.[7] Compared with patients with known CAD, patients with PAD were less likely to be on these protective medications. This highlights the importance of recognizing PAD as a major risk factor for cardiovascular events and a stimulus to initiate proper therapy.

Efforts to improve medication utilization are underway nationally. The Society for Vascular Surgery has sponsored a National Quality Forum measure for AP use following carotid interventions.[20] Additionally, the Department of Health and Human Services has sponsored the Million Hearts initiative. The goal of this initiative is to prevent one million heart attack and strokes by 2017 by ensuring appropriate medical treatment and smoking cessation for those with cardiovascular disease.[21]

Despite these national efforts, patient care coordination is a result of complex factors such as practice patterns, referrals, health systems, insurance, compliance, and socioeconomic issues. Unfortunately, these details are unavailable in the VSGNE dataset. Therefore, future research is necessary to identify the barriers to proper medication utilization. The Vascular Quality Initiative and the Society for Vascular Surgery are in unique positions to promote such quality efforts.[22] Regional quality groups are well suited to undertake quality improvement initiatives such as increasing optimal medical management. As the VSGNE has been able to demonstrate, a regional collaborative effort can successfully improve clinical practice. This was seen with increasing the use of patch closure during CEA[23] and increased beta-blockade utilization.[24] Going forward, appropriate perioperative AP and statin usage will be a major quality initiative of the VSGNE.

Our study has several important limitations. Specifically, the dosage of each medication is unknown. Also, we are unable to determine the adherence to medication utilization after discharge. Our data (not shown) demonstrates that 84% of patients who were discharged on both AP and statin agents remained on both at 1-year follow-up. However, a third of patients had missing data points in medication use at 1 year. This makes drawing any firm conclusions difficult. We do not have data beyond 1 year. Second, due to the nature of the VSGNE dataset, we do not have biochemistry data for each patient to evaluate platelet response to AP agents or lipid and inflammatory markers to assess the adequacy of statin treatment. However, if many patients are being medically undertreated, this would underestimate the potential effect of these medications. The true impact of optimal medical treatment may actually be larger than we are able to identify in the present study. Next, it is possible that our dataset has underreported the number of patients intolerant to these agents. Our analysis grouped patients intolerant to each medication with those not taking them for other reasons. This was to identify the overall mortality benefit of these agents. Unfortunately, we are also unable to assess hemoglobin A1c levels or blood pressure measurements, which are also important in the medical management of these patients. Lastly, due to the observational nature of our dataset, we can demonstrate association, but not causation for optimal medical therapy and 5-year survival. Patients were taking, or not taking, these medications for various reasons, including socioeconomic, access to care, and other contextual variables. This may affect a patient's ability to take optimal medical therapy for their cardiovascular disease and have an impact on their long-term survival. This further emphasizes the need to ensure that each patient undergoing vascular surgery is receiving optimal care to obtain the best outcomes following vascular procedures.

In summary, this study shows that only 66% of patients undergoing selected vascular operations were on optimal medical management. There is wide variation in medication utilization among centers and procedures in New England. Patients on optimal medical therapy had lower 30-day mortality and a statistically significant improvement in 5-year survival, resulting in an 18% absolute survival benefit at 5 years.

CONCLUSIONS

Despite the widespread acceptance of AP and statin therapy among patients with PAD and cardiovascular disease, many patients remain on suboptimal therapy while undergoing major vascular procedures. This variation is associated with increased mortality following carotid interventions and lower extremity bypass, as well as aneurysm repair. A relatively simple modification in medical management could have a potentially profound impact on patient outcomes. Future quality improvement efforts need to focus on identifying the factors associated with this level

of variation. Additionally, understanding the barriers to appropriate medication utilization should be identified to ensure each patient undergoing interventions for vascular disease is on optimal medical therapy.

AUTHOR CONTRIBUTIONS

Conception and design: RD, BN, DS, JC, PG
Analysis and interpretation: RD, JJ, BN, DS, JA, DB, JC, PG
Data collection: RD, JJ, BN, DS, JA, DB, JC, PG
Writing the article: RD, JJ, JC, PG
Critical revision of the article: RD, JJ, BN, DS, JA, DB, JC, PG
Final approval of the article: RD, JC, PG
Statistical analysis: RD, PG
Obtained funding: Not applicable
Overall responsibility: RD

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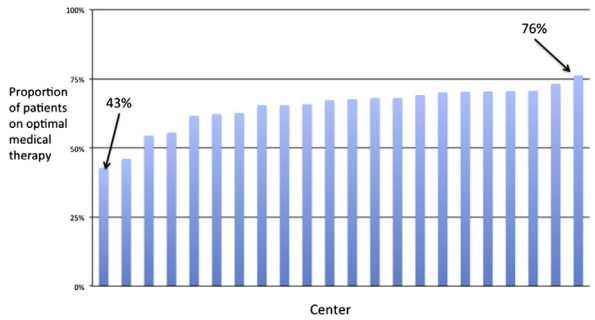

Supplementary Fig (online only). Variation in optimal medical therapy across Centers in the Vascular Study Group of New England (VSGNE) for centers with >100 cases (2005-2012).

Supplementary Table (online only). Unadjusted survival in the Vascular Study Group of New England (VSGNE), 2005-2012

	Suboptimal medical therapy at DC	*Optimal discharge medication at DC*	P	*Unadjusted HR*	P
All	70% (67%-73%)	79% (77%-81%)	<.001	0.64 (0.58-0.73)	<.001
CEA	76% (72%-81%)	83% (81%-85%)	.002	0.73 (0.60-0.89)	.002
CAS	52% (34%-68%)	70% (60%-78%)	.211	0.71 (0.41-1.22)	.214
oAAA	77% (70%-83%)	83% (77%-87%)	.045	0.66 (0.44-0.99)	.047
EVAR	71% (63%-77%)	75% (70%-80%)	.004	0.64 (0.48-0.87)	.004
Supra[a]	83% (73%-89%)	95% (92%-97%)	.001	0.29 (0.13-0.65)	.003
Infra	61% (56%-66%)	69% (65%-74%)	.001	0.73 (0.60-0.89)	.001

CAS, Coronary artery stenting; *DC*, discharge; *EVAR*, endovascular aneurysm repair; *HR*, hazard ratio; *Infra*, infrainguinal artery bypass; *oAAA*, open abdominal aortic aneurysm repair; *Optimal*, on both antiplatelet and statin therapy at discharge; *Suboptimal*, either single agent or neither agent at discharge; *Supra*, suprainguinal artery bypass.

[a]Three-year survival displayed. Suprainguinal bypass has only been tracked since 2009.